MCP361 Industrial Engineering Lab: Assignment 1

Due date: 9:00 AM July 31, 2024

- **Naming convention for files for this assignment is as follows**
  MCP361_Entry#_Assignment1_Problem1.py
  MCP361_Entry#_Assignment1_Problem2a.py
  MCP361_Entry#_Assignment1_Problem2b.py
  MCP361_Entry#_Assignment1.pdf

- **Submit a zip file to Moodle named as follows**
  MCP361_Entry#_Assignment1.zip

Remember the general guidelines for the assignments given at the start of the course.

Q1) (3 marks) Formulate and solve the following assignment problem as an integer linear programming problem. Note that total costs of performing each task need to be minimized, and each person can perform only one task, and each task needs only one person. Print the 5x5 allocation matrix and the optimal cost. Use PuLP for the rest of this assignment. You can learn more about PuLP here: https://coin-or.github.io/pulp/.

Cost	Task 1	Task 2	Task 3	Task 4	Task 5
Person 1	40	45	43	60	58
Person 2	44	56	48	45	48
Person 3	52	39	45	51	41
Person 4	40	61	49	72	45
Person 5	55	45	46	52	43

[1 mark] Note that you need to **write** your formulation (not just implement it) in a PDF file (e.g., write in Overleaf like a_{ij} x_{ij} \geq d_{ij}). You also need to **write** down your code output in the PDF and then interpret the code output.

Q2) Solve the problem below using PuLP in python.

You have just been made corporate vice president in charge of manufacturing for an automotive components company and are directly in charge of assigning products to plants. Among many other products, the firm makes automotive batteries in three grades: heavy-duty, standard, and economy. The unit net profits and maximum daily demand for these products are given in the first table below. The firm has three locations where the batteries can be produced. The maximum assembly

capacities, for any mix of battery grades, are given in the second table below. The number of batteries that can be produced at a location is limited by the amount of suitably formulated lead the location can produce. The lead requirements for each grade of battery and the maximum lead production for each location are also given in the following tables.

Product	**Unit Profit (INR/battery)**	**Maximum Demand (batteries/day)**	**Lead Requirements (Kg/battery)**
Heavy-duty	12	700	21
Standard	10	900	17
Economy	7	450	14

Plant Location	**Assembly Capacity (batteries/day)**	**Maximum Lead Production (Kg/day)**
1	550	10000
2	750	7000
3	225	4200

[1 mark] Note that you need to **write** your formulation (not just implement it) in a PDF file (e.g., write in Overleaf like a_{ij} x_{ij} \geq d_{ij}). You also need to **write** down your code output in the PDF and then interpret the code output.

a. (3+0.5 marks) Formulate and solve an ILP that allocates production of the three grades among the three locations in a manner that maximizes profit. Print the 3x3 allocation matrix and the optimal profit. **What** observation do you make regarding the batteries of economy type?

b. (1+0.5 marks) Also re-solve the problem additionally specifying that at least 40% of the total number of batteries made must be economy type. Print the 3x3 allocation matrix and the optimal profit. **What** observation do you make regarding the batteries of standard type?